Boom Effectiveness, Pre-Booming, and Alternative Measures

Boom Types and Effectiveness

Washington Department of Ecology SPPR

Information for this presentation was derived from the ExxonMobil *Oil Spill Response Field Manual, Fluent Inc., Slickbar, and Mechanical Protection Guidelines, June 2004.*

Definitions

- Pre-boomed and Pre-deployed: boom in water around vessel and transfer area.

- Pre-staged or Quick boom: boom in water or on-scene (such as on a reel) for immediate deployment. This means that not locked in trailer, stored, or unavailable until removed from a container.

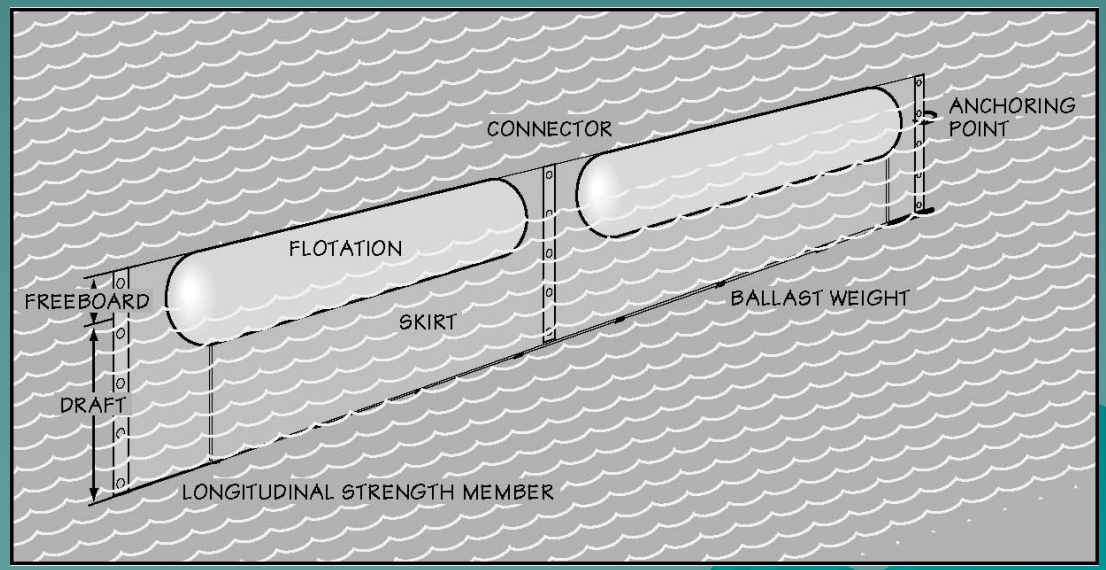
Boom Types and Effectiveness

Boom works in many cases but not all.

- Ways to classify types of boom;
  - Construction or design
  - Use
- Boom failure;
- Boom selection and applications.

Basic Boom Types

- Boom may be classified by its area of use:
  - Open Water Boom
  - Protected Water Boom
  - Intertidal Boom
  - Fast Water



Basic Boom Types

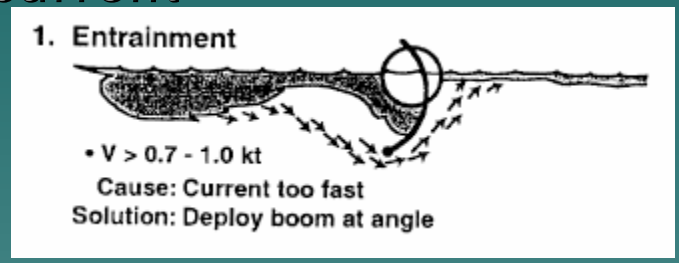
- Boom may also be classified into four basic design types:
  - Internal Foam Flotation
  - Self-Inflating
  - Pressure-Inflatable
  - Fence

Specialty boom is available with sorbent and fire-resistant materials, shore sealing barriers, and netting to trap high viscosity or solidified oil.

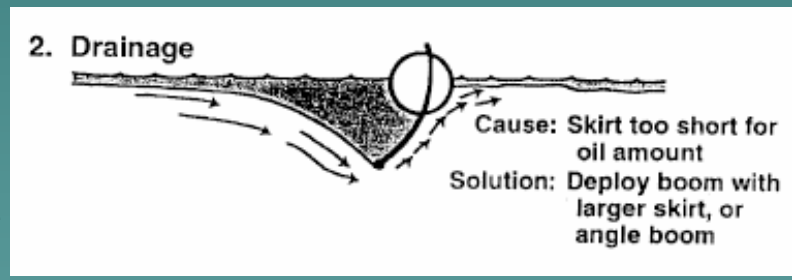
Entrainment

Reasons for Boom Failure

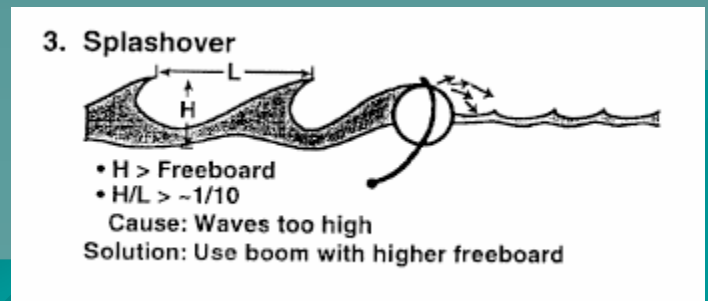
- Marine Oil Containment Boom is very effective at containing oil, but the booms effectiveness can be degrade in five distinct ways.
  - – Entrainment occurs when the water current builds up against the boom creating a barrier before the boom that can force the oil down under the boom.



  - – Drainage occurs when oil builds an underwater ramp up against the boom is carried under the boom with the current.

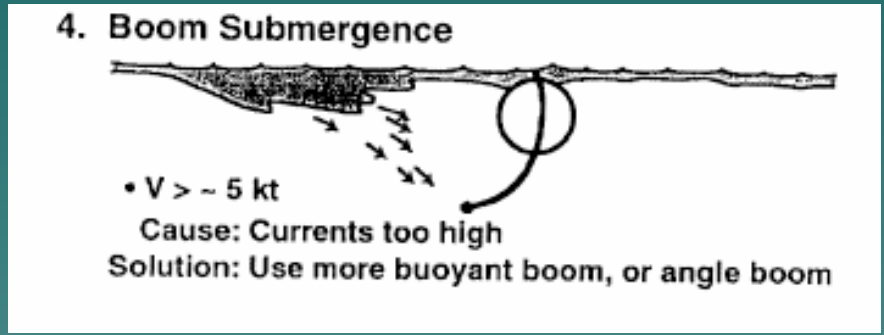


  - – Splashover occurs when the wave height to wave frequency ratio vs. boom height is such that the wind and wave action fling oil up and over the boom.

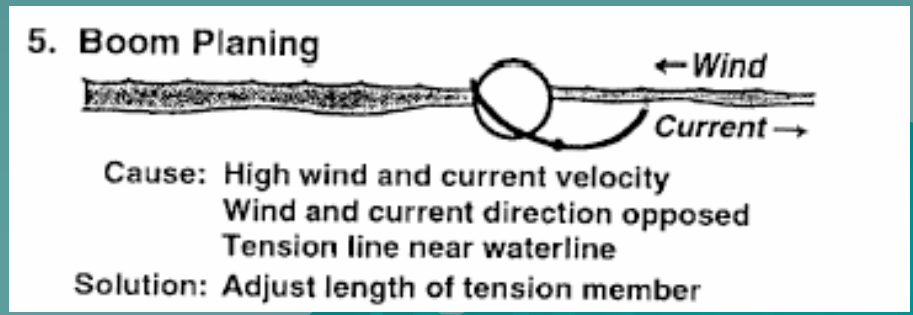


Reasons for Boom Failure Continued

–Submergence happens when the boom length is to short for the current and the boom is physically pushed underwater causing failure.



–Planing occurs when wind forces push the top of the boom (called the sail) one direction and the current pushed the bottom of the boom (called the skirt) a different direction. These two forces cause the boom to assume a horizontal or flat attitude that greatly reduces its ability to contain oil.



Boom Selection and Application

- Booms are used for two dominant applications:
  - Containment > boom is used in little or no current to isolate a spill, control spreading, concentrate oil, facilitate recovery by skimmers.
  - Deflection > boom is deployed at an angle to a drifting slick to divert oil away from sensitive areas or to a collection point.

Boom Selection and Application

- When selecting boom you should consider:
  - Mode of deployment and time likely required;
  - Possible locations of use;
  - Types of vessels used for deployment;
  - Potential sea and debris conditions;
  - Approximate duration of operation and boom use.
  - Compatibility of connection devices

Boom Selection and Application

Boom performance versus conditions:

Wind	Waves	Current	Boom Performance
0 – 10 knots (0 – 20 km/hr)	Calm, swells	0 – 0.5 knots (0.25 m/s)	 Good
> 20 knots (40 km/hr)	< 3 – 4 foot (1 m)	> 1 knot (0.5 m/s)	 Poor

Boom Size Chart

Service	Freeboard (inches)	Draft (inches)	Sea Condition (wave height)
Shallow-water	0 and above	< 6 calm	Calm
Inland/River	4-10	6-12	< 1 Foot
Harbor/Great Lakes	10-18	12-24	< 3-4 feet
Open-Water	> 18	> 24	< 6 feet

Boom Selection and Application

Boom Selection Matrix

		Type of Boom			
		Internal Foam Flotation	Self Inflating	Pressure Inflatable	Fence
Environmental Conditions	Open Water	**F**	**F**	**G**	**P**
	Protected Water	**G**	**G**	**G**	**F**
	Calm Water	**G**	**G**	**G**	**G**
	High Current (>1kt)	**F**	**P**	**F**	**P**
	Shallow Water (<1ft)	**G**	**F**	**F**	**P**
Performance Characteristics	Operation in Debris	**G**	**P**	**F**	**F**
	Excess Buoyancy	**F**	**G**	**G**	**P**
	Wave Response	**F**	**F**	**G**	**P**
	Strength	**F**	**P**	**G**	**G**
Convenience Characteristics	Ease of Handling	**F**	**G**	**F**	**F**
	Ease of Cleaning	**G**	**G**	**G**	**G**
	Compactibility	**P**	**G**	**G**	**P**
Legend	**G = Good**	**F = Fair**		**P = Poor**	

Open Water	Wave height >3ft	Current velocity <1kt
Protected Water	Wave height 1 – 3ft	Current velocity <1kt
Calm Water	Wave height <1ft	Current velocity <0.5kt

Not all boom of a particular type have the rating indicated above.

What is required?

33 CFR 155.775 Cargo tanks must not be filled more than 98.5%

- 46 CFR 39.7-9 Tankship and Tank Barge

- § 39.20-7 Tankship liquid overfill protection—T/ALL.

(a) Each cargo tank of a tankship must be equipped with an intrinsically safe high level alarm and a tank overfill alarm.

Change Topic

- Tank Vessel Alarm requirements

What is required? Cont.

Choices…

- § 39.20-9 Tank barge liquid overfill protection-B/ALL.

Each cargo tank of a tank barge must have one of the following liquid overfill protection arrangements.

- (a) A system meeting the requirements of §39.20–7 of this part which: -→*follows tankship design*

OR

- (b) An intrinsically safe overfill control system which:
  (1) Is independent of the cargo gauging device required by §39.20–3(a) of this part;
- (2) Actuates an alarm and automatic shutdown system at the facility overfill control panel, or on the vessel to be lightered *(delivering vessel)* if a lightering operation, 60 seconds before the tank becomes 100 percent liquid full;

Alternatives

Currently required technology by Coast Guard

- High level alarm – 95%
- Overfill (high-high) alarm – 98%

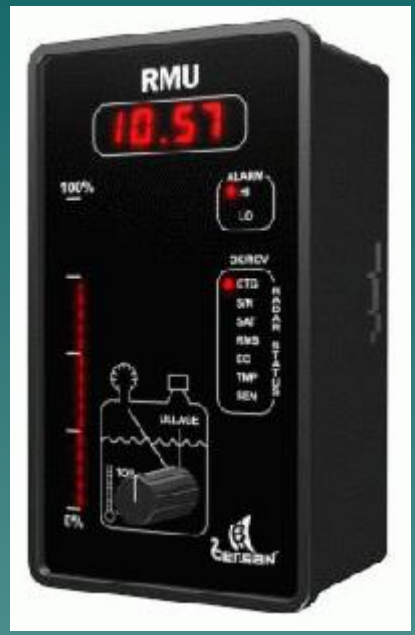
Portable Alarm Unit
~ $1200

In-tank sensor
~ $2600

Alternatives Cont.

Not required

- Umbilical cord (manual shutoff)
- Automatic shutoff
- Redundant non-mechanical level indicator



Tank monitor unit
~ varies on complexity

Redundant In-tank Sensor ~ $3000

In-tank Radar sensor
~ $3000

Alternatives Cont.

- Extra personnel on watch, during transfer
- Meet ECOPRO Standard #8 for TB/ATB's
  - Deliverer provides receiver with means to remotely shutdown deliverer pumps. Essentially an extension cord for existing emergency shutdown system.

Prevention is our goal before all else.

For Reference – 155.480
46 CFR 39.20-7 Tankship liquid overfill protection—T/ALL.

(a) Each cargo tank of a tankship must be equipped with an intrinsically safe high level alarm and a tank overfill alarm.

(b) The high level alarm and tank overfill alarm required by paragraph (a) of this section, if installed after July 23, 1990 must:

(1) Be independent of each other;

(2) Alarm in the event of loss of power to the alarm system or failure of electrical circuitry to the tank level sensor; and

(3) Be able to be checked at the tank for proper operation prior to each transfer or contain an electronic self-testing feature which monitors the condition of the alarm circuitry and sensor.

(c) The high level alarm required by paragraph (a) of this section must:

(1) Alarm before the tank overfill alarm, but no lower than 95 percent of tank capacity;

(2) Be identified with the legend “High Level Alarm” in black letters at least 50 millimeters (2 inches) high on a white background; and

(3) Have audible and visible alarm indications that can be seen and heard on the vessel where cargo transfer is controlled.

(d) The tank overfill alarm required by paragraph (a) of this section must:

(1) Be independent of the cargo gauging system;

(2) Have audible and visible alarm indications that can be seen and heard on the vessel where cargo transfer is controlled and in the cargo deck area;

(3) Be identified with the legend “TANK OVERFILL ALARM” in black letters at least 50 millimeters (2 inches) high on a white background; and

(4) Alarm early enough to allow the person in charge of transfer operations to stop the transfer operation before the cargo tank overflows.

(e) If a spill valve is installed on a cargo tank fitted with a vapor collection system, it must meet the requirements of §39.20–9(c) of this part.

(f) If a rupture disk is installed on a cargo tank fitted with a vapor collection system, it must meet the requirements of §39.20–9(d) of this part.

46 CFR 39.20-9 Tank barge liquid overfill protection—B/ALL.

Each cargo tank of a tank barge must have one of the following liquid overfill protection arrangements.

(a) A system meeting the requirements of §39.20–7 of this part which:

(1) Includes a self-contained power supply;

(2) Is powered by generators installed on the barge; or

(3) Receives power from a facility and is fitted with a shore tie cable and a 120 volt 20 amp explosion-proof plug which meets:

(i) ANSI/NEMA WD6;

(ii) NFPA 70, Articles 410–57 and 501–12; and

(iii) §111.105–9 of this chapter.

(b) An intrinsically safe overfill control system which:

(1) Is independent of the cargo gauging device required by §39.20–3(a) of this part;

(2) Actuates an alarm and automatic shutdown system at the facility overfill control panel, or on the vessel to be lightered if a lightering operation, 60 seconds before the tank becomes 100 percent liquid full;

(3) Is able to be checked at the tank for proper operation prior to each loading;

(4) Consists of components which, individually or in series, will not generate or store a total of more than 1.2 V, 0.1 A, 25 mW, or 20 microjoules;

(5) Has at least one tank overfill sensor switch with normally closed contacts per cargo tank;

(6) Has all tank overfill sensor switches connected in series;

(7) Has interconnecting cabling that meets §111.105–15(b) of this chapter; and

(8) Has a male plug with a 5 wire, 16 amp connector body meeting IEC 309–1/309–2 which is:

(i) Configured with pins S2 and R1 for the tank overfill sensor circuit, pin G connected to the cabling shield, and pins N and T3 reserved for an optional high level alarm circuit meeting the requirements of this paragraph; and

(ii) Labeled “Connector for Barge Overflow Control System” and with the total inductance and capacitance of the connected switches and cabling.

(c) A spill valve which:

(1) Meets ASTM F 1271 (incorporated by reference, see §39.10–5);

(2) Relieves at a pressure higher than the pressure at which the pressure relief valves meeting the requirements of §39.20–11 operate;

(3) Limits the maximum pressure at the cargo tank top during liquid overfill, at the maximum loading rate for the tank, to not more than the maximum design working pressure for the tank; and

(4) If the vessel is in ocean or coastwise service, has provisions to prevent opening due to cargo sloshing.

(d) A rupture disk arrangement which meets paragraphs (c)(2), (c)(3) and (c)(4) of this section and is approved by the Commandant (G-MSO).